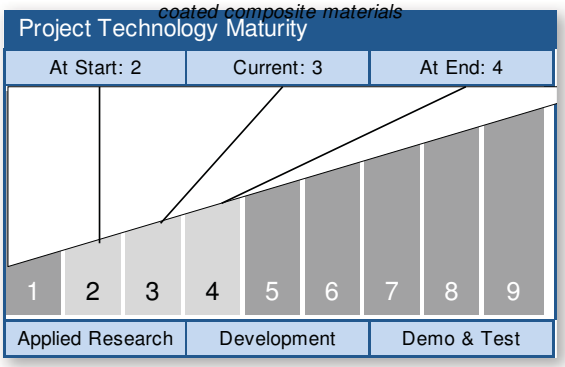
Nanocoatings For Wicking Of Low-Viscosity Cryogens Project

Center Innovation Fund: KSC CIF Program

Space Technology Mission Directorate (STMD)

National Aeronautics and Space Administration

Test apparatus for determining cryogenic wicking in nano-coated composite materials



ABSTRACT

The goal of this project is to develop smart, switchable materials systems for use in thermal management systems, including the evaluation of wicking nanocoatings for use in the transport and storage of cryogens.

Technology Area: Thermal Management Systems TA14 (Primary)
Materials, Structures, Mechanical Systems & Manufacturing TA12 (Secondary)

ANTICIPATED BENEFITS

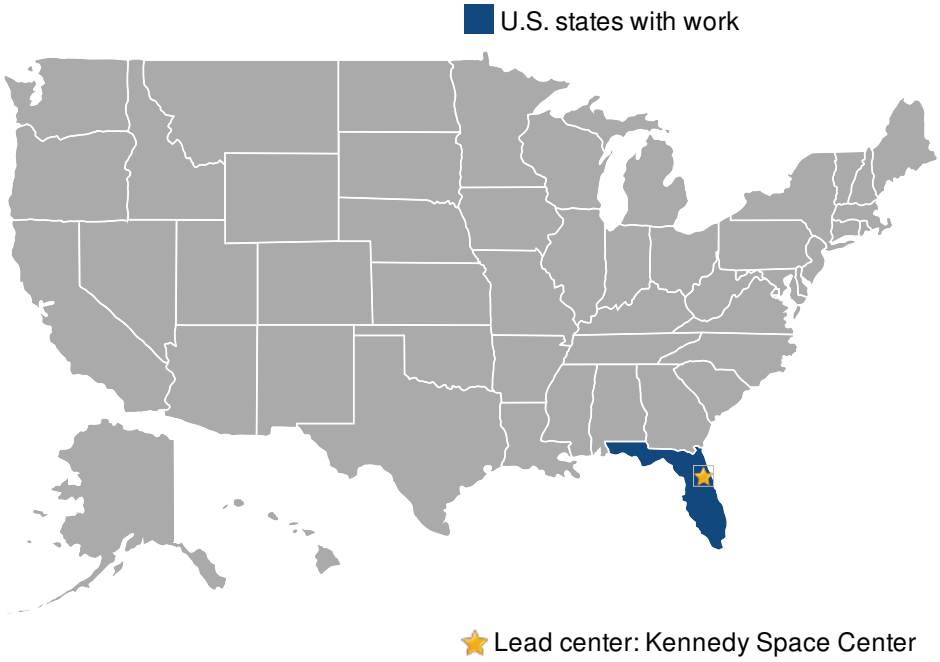
To NASA funded missions:

The advances in cryogenic propellant management technology by use of micro/nano wicking structures proposed in this project may provide a fundamental breakthrough in space propulsion systems. Prototype systems, which are to be developed under this program, will provide game-changing enhanced capability for longer space missions and in management of cryogens in a space environment.

To NASA unfunded & planned missions:

Cryogenic propellant refueling depots have been...

Read more on the last page.



Other Organizations Performing Work
GE Global Research

DETAILED DESCRIPTION

Advances continue to be made in areas of novel materials and mechanical refrigeration equipment for the thermal management of cryogens in applications from space transportation to medical imaging. The investigation of novel materials/systems in combination with mechanical refrigeration equipment for use in thermal management systems is the focus of this project. Materials include coatings and other surface finishes while the refrigeration may be active (with cryocoolers), passive (cryogen only), or a combination. Another important aspect of efficient thermal management is the storage and transport of cryogenic fluids such as liquid hydrogen and liquid helium. These two low-viscosity cryogens are the main challenge and prime target for future applications.

MANAGEMENT

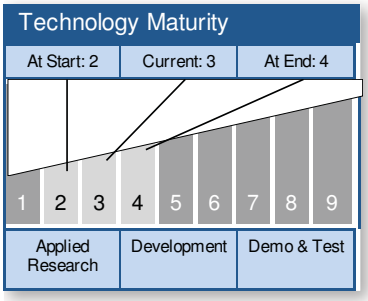
Project Manager:
Nancy Zeitlin

Principal Investigator:
Martha Williams

Co-Investigator:
James Fesmire

TECHNOLOGY DETAILS

Nanocoatings for Wicking of Low-Viscosity Cryogens



TECHNOLOGY DESCRIPTION

- The technology centers on the investigation of smart materials/systems for use in thermal management systems. Another important aspect of efficient thermal management is the storage and transport of cryogenic fluids such as liquid hydrogen and liquid helium. It is a collaboration between cryogenic engineering applications and novel materials science research. Nanocoating materials with favorable wicking properties show promise for the small-scale, localized movement of cryogens to enable various thermal management devices.
- This technology is categorized as a hardware system for ground scientific research or analysis
- Technology Area
  - TA14 Thermal Management Systems (Primary)
  - TA12 Materials, Structures, Mechanical Systems & Manufacturing (Secondary)
  - TA10 Nanotechnology (Additional)

CAPABILITIES PROVIDED

Capabilities envisioned by this technology include operationally robust cryogenic fuel tanks that can be safely and rapidly loaded as well as optimized refrigeration of superconducting equipment to minmize electrical power consumption. The combination of novel materials and mechanical/fluid system design approaches may enable new design approaches for complex cryogenic systems for propulsion, power, life support, and scientific apparatus.

The project anticipates advancing the state of the art in space propulsion systems by development of the key enabling wicking technology for cryogenic propellant management devices.

The advances in cryogenic propellant management technology by use of micro/nano wicking structures in this...

TECHNOLOGY DETAILS

POTENTIAL APPLICATIONS (CONT'D)

project could lead to a fundamental breakthrough in space propulsion systems, providing game-changing enhanced capability for longer space missions and in management of cryogens in a space environment.

Spin-offs from this technology development are anticipated to impact handling of cryogens in all types of applications ranging from thermal management of instruments by advanced cryogen heat pipes to the advancement of medical imaging equipment such as MRI.

IMAGE GALLERY

Test apparatus for determining cryogenic wicking in nano-coated composite materials

ANTICIPATED BENEFITS

To NASA unfunded & planned missions: (CONT'D)

suggested.

To other government agencies:

The technology is applicable to energy systems and superconducting power systems of interest to the DOE and DOD.

To the commercial space industry:

Quick and safe loading of cryogenic propellant tanks could be enabled by further development and deployment of this technology.

To the nation:

Immediate benefits would be to medical imaging equipment to reduce electrical power consumption and/or reduce helium usage for more cost effectiveness and further reach to more countries around the world.